Temperature, humidity and pressure regulator

with Ethernet interface

H0530
H3530
H3531
H3531P
H4531
H7530
H7531

Instruction Manual

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Regulator version HxxxxP is designed for compressed air measurement up to 25 bars.

Models marked Hxxxx**Z** are non-standard versions of the devices. Description is not included in this manual.

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1. General safety rules

The following summary is designed to prevent injury hazards or device damage. Operate the instrument in accordance with this manual to prevent electric trauma.

Service should be performed by a qualified person only.

Use a safety ac/dc adapter. Use only an adapter with the power voltage recommended by its manufacturer and which is approved by proper standards. Check that the adapter has undamaged cables and cover.

Connect and disconnect correctly. Do not connect and disconnect a LAN cable or lead-in cables if the device is under electric voltage.

Do not use the instrument without the cover.

Do not use the instrument, if it does not work correctly. If the instrument seems not to work correctly, have it checked by a qualified service person.

Do not use the instrument in an explosive environment.

Read instruction manual before the first device connection, please.

Before you remove probe of the regulator HxxxxP, make sure that the pressure in a pressure chamber (duct, pipe …) and the ambient pressure are in equilibrium.

2. General description

Regulators of Hx5xx line are designed for online monitoring of temperature in °C or °F, relative humidity of air without aggressive ingredients, barometric pressure and three binary inputs for detection of binary signals. Measured temperature and relative humidity are recomputed to following humidity expression: dew point temperature, absolute humidity, specific humidity, mixing ratio and specific enthalpy. It is possible to set correction for altitude (pressure offset) and to choose one of the following pressure units: hPa, kPa, mbar, mmHg, inHg, inH2O, PSI, oz/in2.

The device is equipped with two relay outputs for alarming or controlling of external devices. It is possible to assign any input value to each relay, to set comparing limit, delay, hysteresis and acoustic alarm or change its status by far control with using of Modbus communication protocol. The device is communicating through Ethernet interface. The device is internally separated into two units. The first unit provides measurement and controlling of output relays – there is possible to change these parameters directly through device's keys or TSensor software. The second unit provides all Ethernet services, its configuration is possible through Telnet terminal or TSensor software (this setting is impossible to change through device's keys).

Type	Temperature	Humidity	Pressure	Computed value	Binary inputs
H0530	✓	-	-	-	3x
H3530	✓	✓	-	✓	3x
H3531	✓	✓	-	✓	3x
H3531P*/	✓	✓	-	✓	3x
H4531**/	✓	-	-	-	3x
H7530	✓	✓	✓	✓	3x
H7531	✓	✓	✓	✓	3x

***/** The removable probe for compressed air measurement is noninterchangeable part of the device. The protection of connector is IP67

***/ The type H4531 is designed for two wires connection of external Pt1000 temperature sensor.

Measured values are available from Ethernet interface or are displayed on LCD. If there are two values displayed at one LCD line, they are periodically switched between both readings with period of 4 seconds. Display can be switched OFF totally too. The following formats are supported:

- WWW pages with user-design possibility
- Modbus protocol
- SNMPv1 protocol
- SOAP

The instrument may send a warning message to several defined points if the measured value gets out of adjusted limits. There are the following possible ways to deliver the warning report:

- to send an e-mail to maximum of three e-mail addresses
- to send a SNMP trap to maximum of three IP addresses
- to display an alarm state on the device WWW page
- to send a message to Syslog server

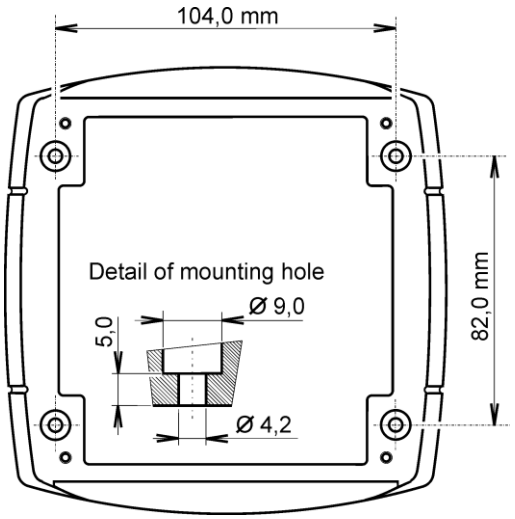
Alarm limits may be set via TSensor software, Modbus, Telnet or a SNMPv1 protocol. The alarm state may be read via the device WWW pages, Modbus or the SNMPv1 protocol.

The value assign to each relay is possible through TSensor software or through device's keys.

If Power over Ethernet is needed, it is necessary to use some PoE Splitter. Tested is e.g. D-Link DWL-P50. Regulator itself does NOT support PoE internally! not supported).

3. Regulator mounting and connection

Regulators are designed for wall mounting. Device must be mounted on the plane surface to prevent its deformation. Mounting holes and connection terminals are accessible after demounting of four screws in the corners of the box and removing the lid. There is recommended to use screws with half round head with cross-recessed screw ST 3.9 (DIN 7981). Lace the lead-in cable with outer diameter of 3 to 6.5 mm through the glands at the case wall and connect them according schematic below. Terminals are self-clamping and can be opened by a suitable screwdriver. For the opening, insert the screwdriver to smaller terminal hole and lever by him. Do not forget to tighten glands and case lid with inserted packing after cables connecting. Insert attached plug into unused cable glands too. Do not connect the regulator under voltage.



It is not recommended to use the device for long time under condensation conditions. It could be the cause of water steam condensation inside the sensor's cover into water phase. This liquid phase stays inside sensor's cover and can't escape from the cover easily. It can dramatically increase response time to relative humidity change. If water condensation occurs for longer time it can cause sensor damage. Similar effect can occur under water aerosol conditions.

External temperature probe connectable to H4531 must be type of "two wires with shielding". The probe cable length and size of conductor affects measurement accuracy. If connected probe is equipped with metal stem, we recommend using probes with metal stem not connected to cable shielding. Or else it is necessary to arrange metal stem is not connected to any other circuitry.

The cables for binary inputs and external sensor for regulator H4531 must be placed as far as possible from potential interference sources. Maximum cable length is 10 m. The cable shielding connect to proper terminal of the device and do not connect it to any other circuitry and do not ground it.

The output relays of device are not able to switch power circuits or higher voltages. In such case we should use suitable type of power relays with coil in accordance to regulator relays specification. For wiring see Appendix A.

The device H3531P is designed to measure pressured air. It is good to mount probe directly into high pressure area (i.e. air pressured pipe) if it is possible. There is other possibility to use flow chamber SH-PP, see Appendix B.

Electrical system (wiring) may be done only by a worker with required qualification by rules in operation.

4. Preparation to operation

To provide all Hx5xx regulator functions it is necessary to make its setting through PC to satisfy your requirements. Requested parts necessary for operation:

- ac/dc adapter 9-30V (200mA) or PoE splitter
- RJ-45 LAN connection
- free IP address in your network
- temperature probe with a Pt1000 sensor for the H4531 regulator

Contact network administrator to get free IP address.

Warning! Reliability of warning messages reception (e-mail, trap) depends on current accessibility of required network services. It is recommended to protect device from unauthorized access to device settings and cables connection.

4.1. Procedure of instrument connection

The cables, power adapter (PoE splitter) and temperature probe for H4531 connect in order as shown in the pictures. After power supply connection, make regulator configuration.

H0530
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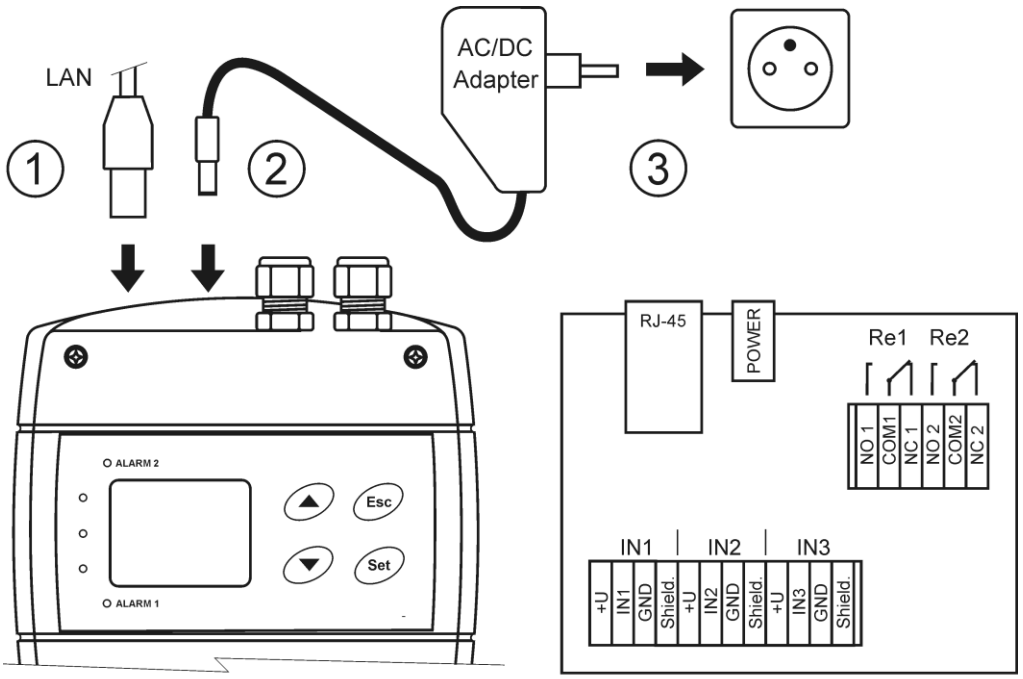
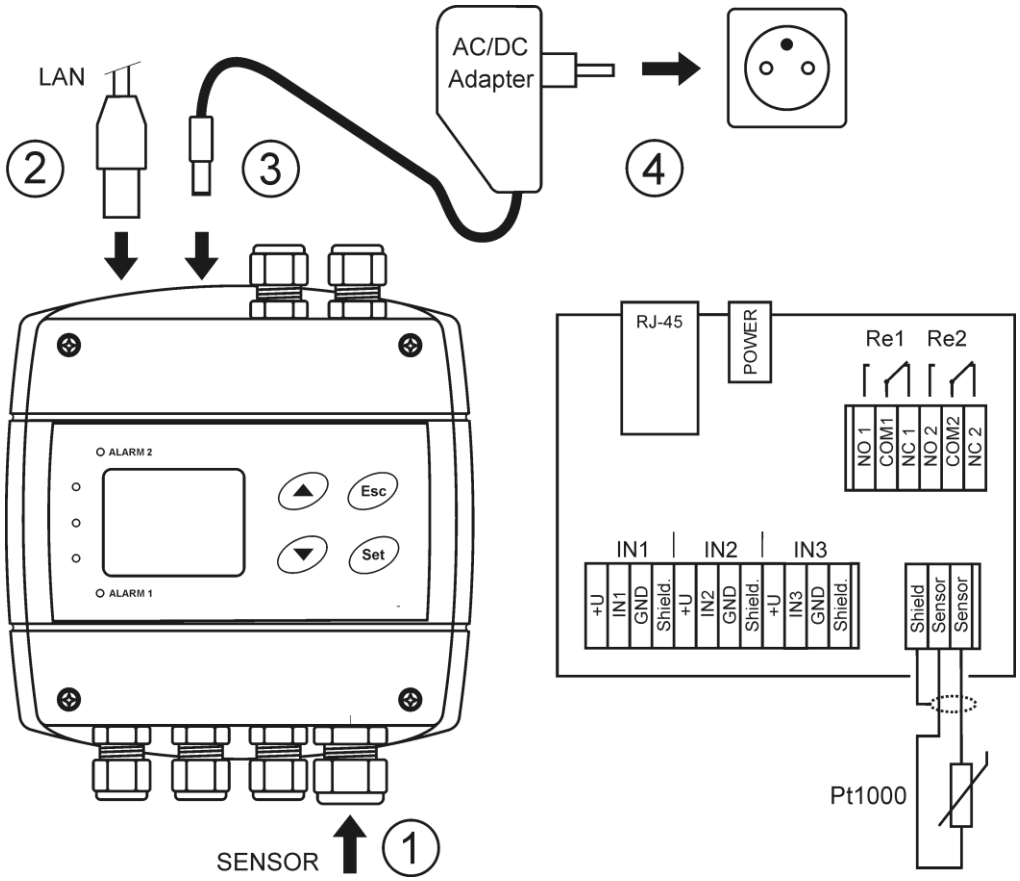
H3531P
H7530
H7531



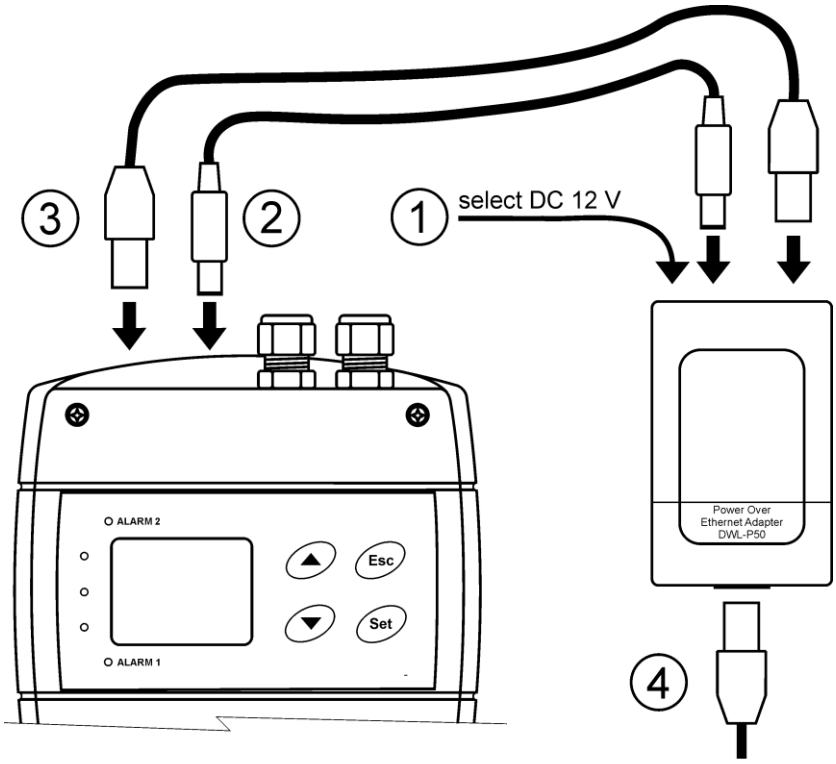
Binary inputs are not galvanic isolated, connection terminals +U are internally connected to the device power supply (ie. the +U terminals provide the same voltage level as power supply).

H4531



Binary inputs are not galvanic isolated, connection terminals +U are internally connected to the device power supply (ie. the +U terminals provide the same voltage level as power supply).

PoE splitter



5. Dimensions

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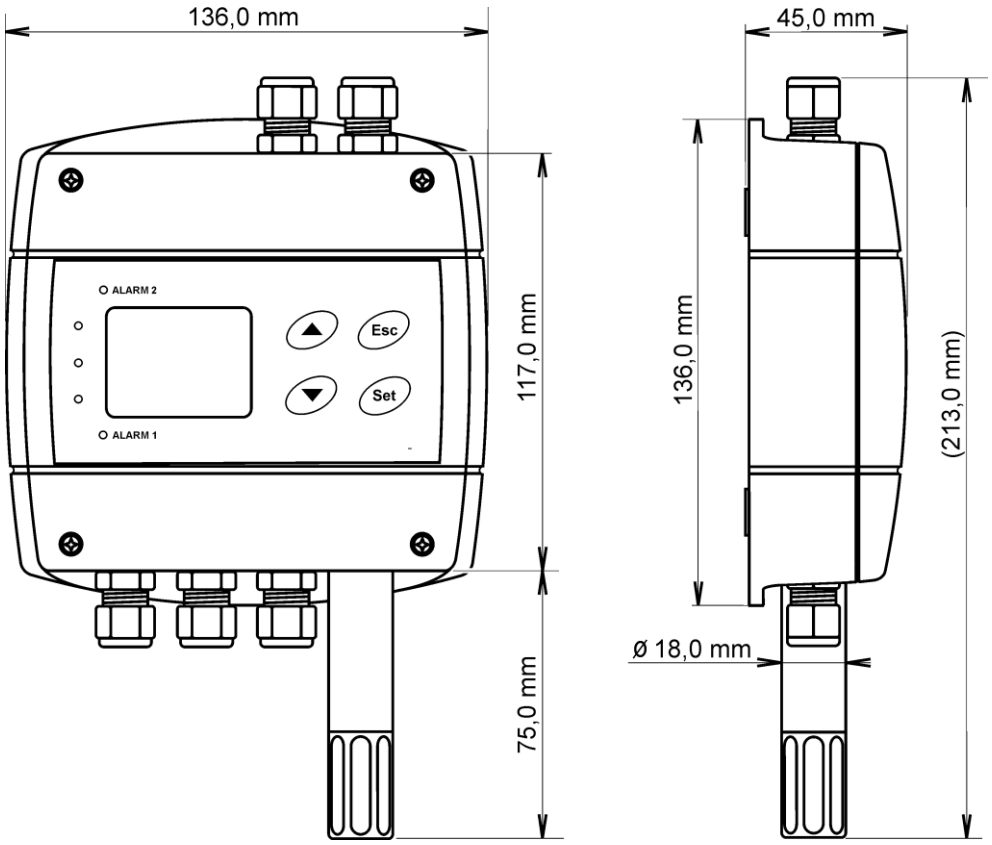
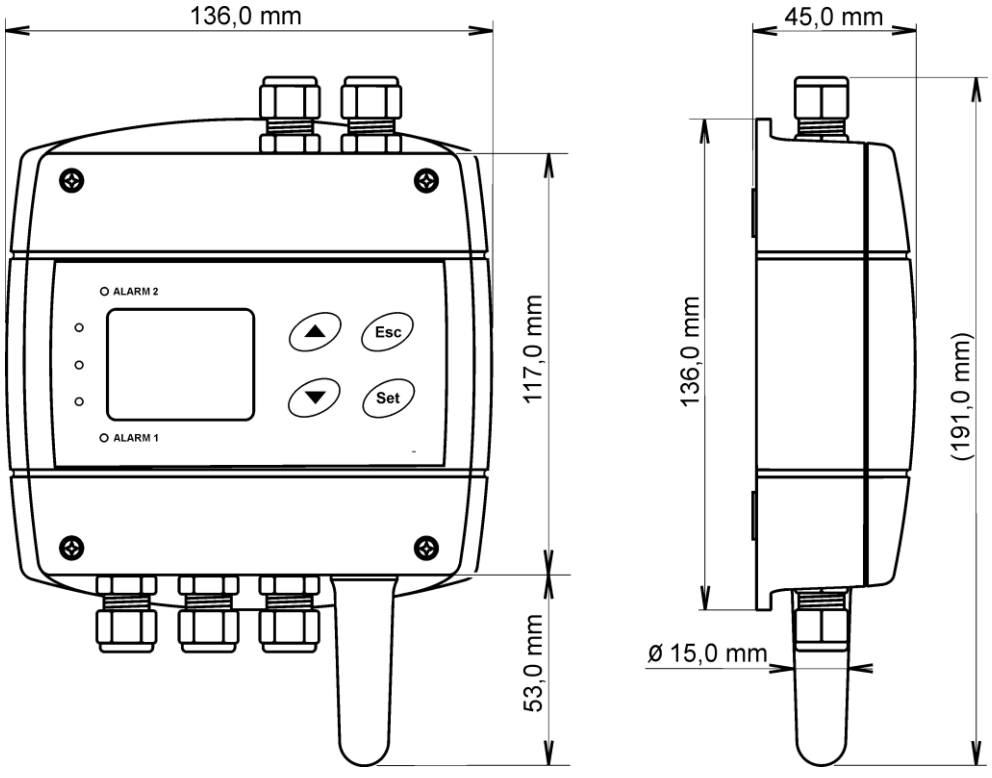
H7530

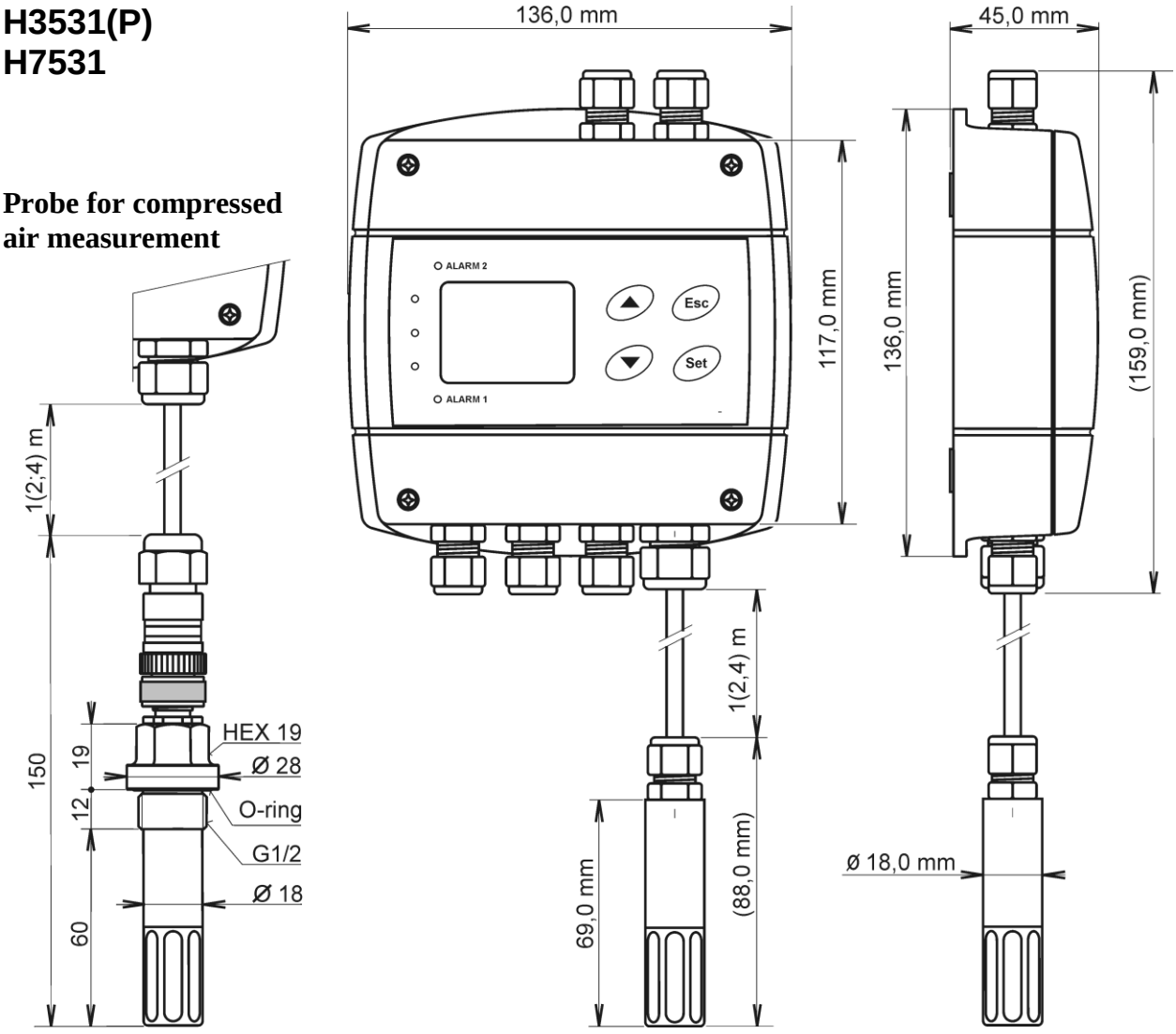


H0530

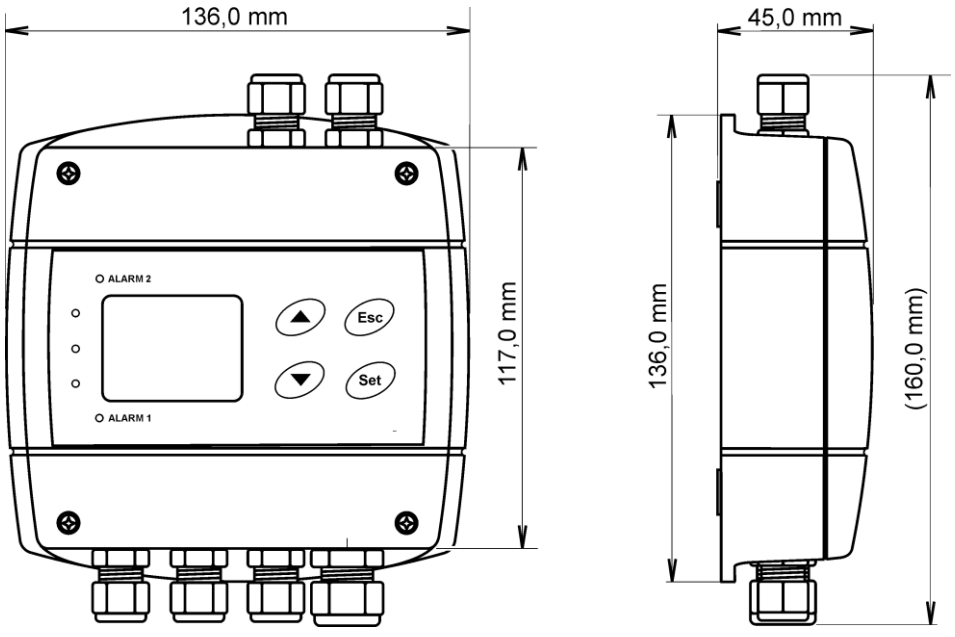


H3531(P)
H7531

Probe for compressed air measurement



H4531



6. Installation

It is necessary to assign a new suitable IP address to the device at the first connection to it in order to prevent collisions with already existing network IP addresses, and make the address conform to the local habits. If installing several new devices, connect them to the network one after another! If a suitable IP address is not known, contact your network administrator and ask him for the following:

IP address of regulator	_____._____._____._____
IP address of gateway	_____._____._____._____
Network mask	_____._____._____._____

The IP gate address and the network mask need not be specified if the device will be operated only in a local network. If you set the IP address to one which is already used in the network the device will NOT work correctly and collisions in the network will appear. It is possible to set the IP address by DHCP server.

Device setting from the manufacturer:

IP address:	**192.168.1.213**
Gateway:	**not set**
Value assigned to Relay1 and Relay2:	**none**
Password for setting through keys (PASS):	**0000**
Password for setting via TSensor:	**none**
Value shown at first LCD line:	**temperature, temperature/pressure - by device type**
Value shown at second LCD line:	**relative humidity/dew point temperature - by device type**
Temperature unit:	**°C**
Pressure unit:	**hPa**
Correction for altitude:	**0 hPa (absolute pressure)**
Computed value preset:	**dew point temperature**
Relay response for error:	**stay unchanged at previous condition**
Signalization of binary inputs status:	**LED diode lights if input contact is open**
Acoustic alarm:	**off**

6.1. Installation procedure

- run TSensor software (default regulator IP address is `192.168.1.213`) or use command line at PC with command „`telnet 192.168.1.213 9999`“. Telnet provides to set all Ethernet services. For setting of measurement and controlling of output relays use keys – see chapter ***8.4***
- assign new regulator IP address
- make your own regulator setting by your requirements (alarm settings, used units, email and trap sending ...)
- save setting

7. Operation checking

7.1. Visual check

When power source is on, there are actually measured values shown on LCD display (if the LCD has not been switched off). When Ethernet cable is connected, there is one light on its connector lighting.

7.2. Communication check via a LAN

Open a browser of WWW pages and enter the devices IP address into appropriate field.

Example: `http://192.168.1.213`

Regulator shows its name, serial number, measured values, alarm status and alarm settings or shows message `Access denied` in case of web pages are disabled or setting through Telnet is in operation.

8. Description of device function and setting

Information from regulator is available directly through LCD or you can read them with one of next communication protocols. For communication through some communication protocol (SNMPv1, Modbus, SOAP) there is necessary to have installed appropriate software supporting appropriate communication protocol on PC. Such software is not included in the delivery! The device is internally separated into two units. The first unit provides measurement and controlling of output relays – these parameters are possible to change directly through device's keys or TSensor software. The second unit provides all Ethernet services, its configuration is possible through Telnet terminal or TSensor software (this setting is impossible to change through device's keys).

8.1. Relay outputs

Regulator is equipped with two relay outputs. It is possible to assign any input or computed value or "far control" to each relay, to set comparing alarm limit, if the relay may close if measured value is higher (Hi) or lower (Lo) than preset limit, delay for while must be preset condition true before relay close its contact and hysteresis for return to open status. For binary inputs: if it is preset to „HI" then output relay is closed when input contact is opened, if it is preset to „Lo" then output relay is closed when input contact is closed. Each relay status is indicated with LED diode and shown on LCD with corresponding symbols „ALARM 1" or „ALARM 2".

The output relays of device are not able to switch power circuits or higher voltages. In such case we should use suitable type of power relays with coil in accordance to chapter ***13.1.1*** at page 29. For wiring see Appendix A.

8.2. Binary inputs

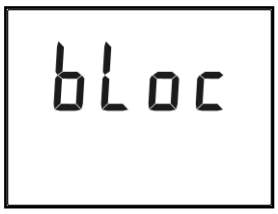
It is possible to read three binary inputs status. It is possible to connect "open contact" or external voltage. Auxiliary power supply +U terminal can be used to supplying of external sensors and detectors. Visualization of binary inputs is done by three LED diodes placed on the left side from LCD. Green one represents input Binary 1, yellow input binary 2 and red input binary 3. If binary input is not connected or is without any signal, then binary input is interpreted as „1", when input contact is closed (connected input), then binary input is interpreted as „0". For each binary input there is possible to set indication LED function – if is lighting when binary input is closed or opened. Binary input status can be assigned to any of output relays.

8.3. Actual regulator preset – measurement part

It is not possible to make any changes of Ethernet services, for their setting see chapter ”*Regulator configuration – Ethernet interface”* at page 20.

If output relay alarm condition configuration is made using Modbus protocol, keyboard is blocked for this time. During this configuration is a word “bloc” shown in the display.

It is possible to display actual regulator preset on its LCD display by pressing of „▲“ key. LCD shows information about Relay1 and then Relay2 setting step by step. Information about Relay 1 are indicated with symbol „ALARM 1“, for Relay2 with symbol „ALARM 2“ (at right top corner of LCD). It is possible to edit parameters after pressing „SET“ key and entering of correct password „PASS“ – see chapter *“Extended setting mode”* at page 15. Following examples are for Relay1 setting, similarly are displayed values for Relay2. Pressing of „ESC“ key ends this mode and switch to actual value displaying, the same occur if more than 20 s is not pressed any key.

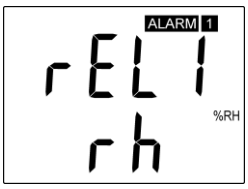


8.3.1. Value assigned to output relay

None, relay is still off

Temperature at °C

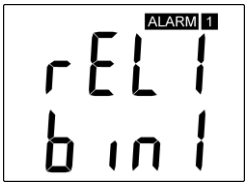
Relative humidity



Computed value – dew point temperature

Barometric pressure

Binary input 1, input 2 and 3 similarly



far condition 0

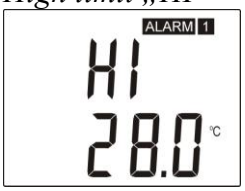
far condition 1

FAR0 – „far condition 0“: after device’s power on the relay is open
FAR1 – „far condition 1“: after device’s power on the relay is close
If “far condition” is assigned to output relay, then there is possible to change the output relay status by Modbus communication protocol only. See chapter *“Modbus protocol”* at page 22.

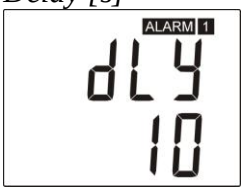
8.3.2. When close output relay

High limit „HI“ – the relay close when measured value exceeds preset „high limit” for longer time than preset „delay time“. Relay goes open when measured value decrease under „high limit“ value minus the „hysteresis” value. See example.

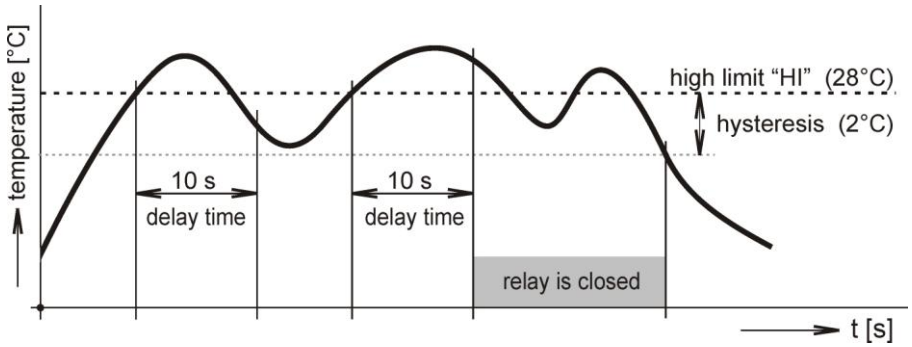
High limit „HI“



Delay [s]

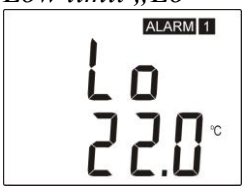


Hysteresis

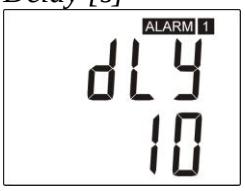


Low limit „Lo“ – the relay close when measured value falls below preset „low limit” for longer time than preset „delay time“. Relay goes open when measured value exceeds „low limit“ value plus the „hysteresis” value. See example.

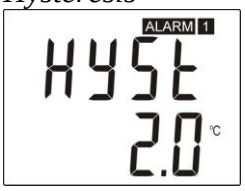
Low limit „Lo“

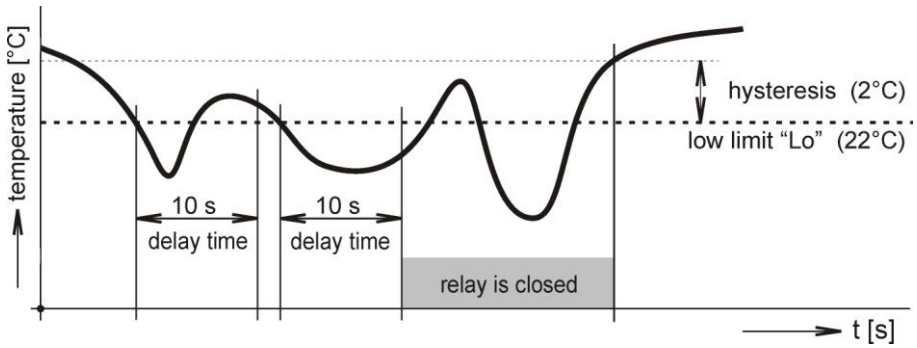


Delay [s]



Hysteresis





8.4. Regulator setting change – part of measurement unit

8.4.1. Setting with PC and TSensor software

User's software **TSensor** is available free to download at web page www.cometsystem.cz. It provides **setting of all regulator parameters**. Run the TSensor program and follow the program instructions. Regulator includes hardware write protection of internal setting (except of Ethernet setting which is protected by password), new setting is possible to write only while:

1. during write period press „SET" key – do requested setting in TSensor software, press „SET" key on regulator and keep it down, then click on the button „Save Changes" into TSensor software and after end of write release „SET" key, or
2. jumper placed nearby keys is closed (jumper is accessible after demounting of four screws in the corners of the box and removing the lid, don't confuse with jumper nearby Ethernet connector!). This jumper is suitable e.g. until device adjustment is in process and regulator is placed into calibration box and keys are not accessible. Don't forget to remove (open) jumper after procedure finish (restore write protection)

TSensor software supports to make the adjustment of the regulator too. This procedure is described at file „*Calibration manual.pdf*" which is installed commonly with the software.

8.4.2. Setting with using regulator keys

If „Actual regulator preset" is displayed (see chapter *"Actual regulator preset – measurement part"* at page 13), it is possible to enter into edit mode and edit displayed value by pressing „SET" key. Then you are asked for valid password „PASS". If password is not valid there is shown for short time message "Err9" on LCD. You can edit selected value if right password is entered. During value editing there is range check executed and edited value is still compared with limits for corresponding value (range). If inserted value is higher or lower then edited number is automatically changed to its maximum / minimum value – for possible range see chapter „Technical parameters" at page 29. Value can be changed with using „▲" and „▲" keys. Edited value is switched in "round" -9, -8, -7, …-2, -1, 0, 1, 2, …8, 9. To edit next number digit press „SET" key, for moving back to previous digit press „ESC" key. Edited value is stored by next „SET" key pressing. It is possible to cancel editing by pressing „ESC" key if necessary. If valid password is once inserted right, then there is possible to edit next items without asking for password insertion again, till "Actual regulator preset" is left (till actual measured values are shown). With new entering into edit mode it is necessary to enter Password again. Default password setting is preset from manufacturer to 0000, password change is possible into „Extended setting". During edit mode regulator still works and changes are valid immediately after its storing – it is NOT necessary to restart regulator.

8.4.3. Extended setting mode

During regulator operation it is possible to change parameters available through "Actual regulator preset" only. Rest of regulator parameters are available through "Extended setting mode". **In this mode regulator does NOT communicate, does NOT do any measurements and does NOT service output relays. To leave this mode press „ESC" key and open jumper nearby keys.**

To enter into extended setting mode do following steps:

1. disconnect power supply
2. demount four screws in the corners of the box and remove the lid
3. closed jumper placed nearby keys (don't confuse with jumper nearby Ethernet connector

4. press „▲“ and „▼“ keys together and keep them down
5. connect power supply to regulator – you should see message „SEL“ on the top line of LCD and on the bottom line you should see number of Firmware version (e.g. 0401)
6. release „▲“ and „▼“ keys – you are into “Extended setting mode” now

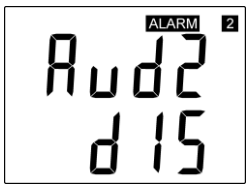
Use „▲“ and „▼“ keys to inspect each items. If you want to change some shown item then press „SET“ key, item starts blink. Now you can edit setting with using „▲“ and „▼“ keys. To store preset value press „SET“ key. Press „ESC“ key to leave editing (changing) without save – last stored value is kept.

Acoustic alarm assign to Relay1 (Relay2)

acoustic indication of Relay1 is OFF

close of Relay1 contact starts acoustic indication

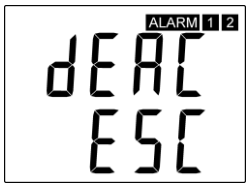
acoustic indication of Relay2 is OFF



close of Relay2 contact starts acoustic indication

Acoustic alarm deactivation

activated acoustic alarm is possible to deactivate by pressing „ESC“ key



acoustic alarm is still activated for all time and it is impossible to deactivate it

Relay response for error

Regulator continuously checks its state during operation. In case error of assigned value measurement is found then output relay:

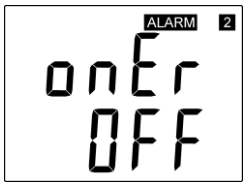
stays unchanged (in previous status)

Relay1 switch OFF

Relay1 switch On

stays unchanged (in previous status)

Relay2 switch OFF

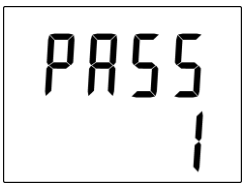


Relay2 switch On

Change of "Password for setting through keys" (PASS)

This item shows actual password setting. It is possible to change it after „SET" key pressing. It is number from range -19999 to +19999.

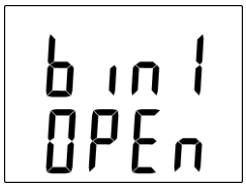
password setting



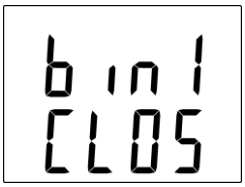
Visualization of binary inputs

Visualization of binary inputs is done by three LED diodes. This option defines at which binary input status should LED diode indication lights – LED diode lights if binary input is OPEN or CLOSED.

LED lights if binary input is OPEN



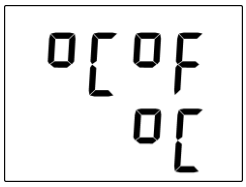
LED lights if binary input is CLOSED



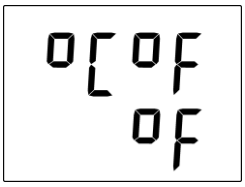
Temperature unit choice

It is possible to measure temperature at °C or °F. There is shown preset unit. It is possible to change it after „SET" key pressing.

preset to °C



preset to °F



Barometric pressure unit choice

It is possible to measure barometric pressure at hPa, PSI, inHg, mBar, oz/in^2, mmHg, inH_2O and kPa. There is shown preset unit. It is possible to change it after „SET" key pressing.

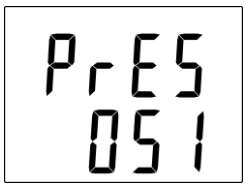
preset to hPa

preset to PSI

preset to inHg

preset to mBar

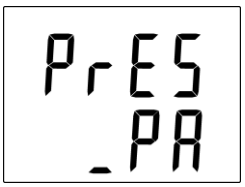
preset to oz/in²



preset to mmHg

preset to inH₂O

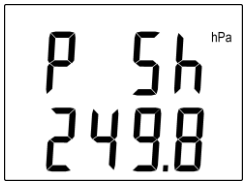
preset to kPa



Setting of pressure correction for altitude

If is there necessary to read value of barometric pressure corrected with respect to altitude, it is possible to set corresponding pressure offset for this altitude. It is possible to change it after "SET" key pressing. Pressure correction value is then automatically added to measured pressure value. See chapter *"Error States of the device"* at page 27, Error 2.

correction for altitude



pressure correction value is from

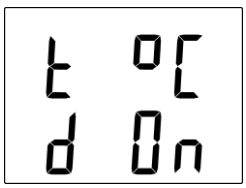
-25,0 to 650,0 hPa
-0,363 to 9,427 PSI
-0,74 to 9,19 inHg
-25,0 to 650,0 mBar

-5,8 to 150,8 oz/in²
-18,8 to 487,5 mmHg
-10,0 to 261,0 inH₂O
-2,5 to 65 kPa

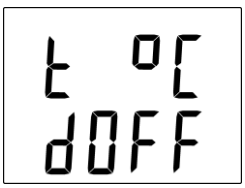
Show temperature at LCD display

This item provides to choice if actual measured temperature may be displayed at LCD display or not. It is possible to change it after „SET" key pressing.

show value on LCD



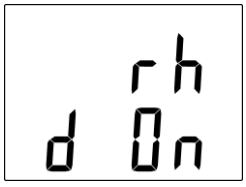
don't show value on LCD



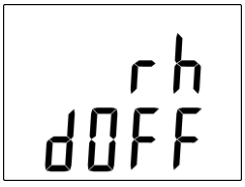
Show relative humidity at LCD display

This item provides to choice if actual measured relative humidity may be displayed at LCD display or not. It is possible to change it after „SET" key pressing.

show value on LCD



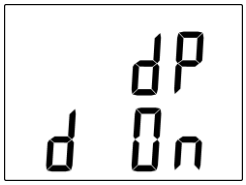
don't show value on LCD



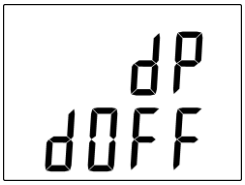
Show computed value at LCD display

This item provides to choice if actual computed value may be displayed at LCD display or not. There is shown the name of computed value on the top LCD line. It is possible to change it after „SET“ key pressing.

show value on LCD



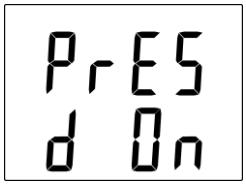
don’t show value on LCD



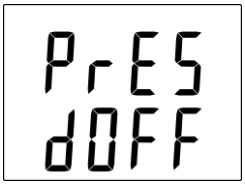
Show barometric pressure at LCD display

This item provides to choice if actual barometric pressure may be displayed at LCD display or not. It is possible to change it after „SET“ key pressing.

show value on LCD



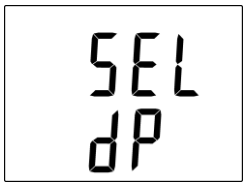
don’t show value on LCD



Computed value selection

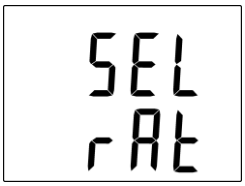
It shows the actually selected computed value name. It is possible to change it after „SET“ key pressing. There is possible choice one of the following computed values:

dew point temperature

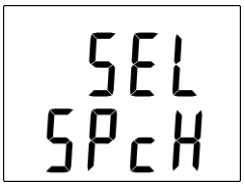


absolute humidity

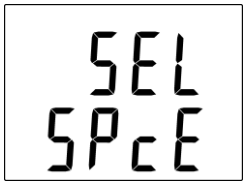
mixing ratio



specific humidity



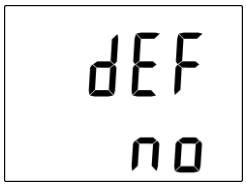
specific enthalpy



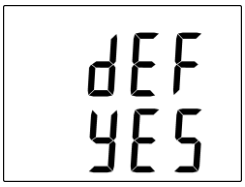
8.5. Restore to „Factory default“ – measurement part

This item provides regulator restoring to factory setting. Press „SET“ key, select „YES“ and confirm it by pressing of „SET“ key. It reset regulator parameters to following values:

Value assigned to Relay1 and Relay2:	**none**
Password for setting through keys (PASS):	**0000**
Display:	**on**
Temperature unit:	**°C**
Pressure unit:	**hPa**
Correction for altitude:	**0 hPa (absolute pressure)**
Computed value preset:	**dew point temperature**
Relay response for error:	**stay unchanged at previous condition**
Signalization of binary inputs status:	**LED diode lights if input contact is open**
Acoustic alarm:	**off**



restore to factory default



8.6. Regulator configuration – Ethernet interface

The Ethernet configuration is performed by TSensor software or Telnet setup[1]. Setting through the Telnet is described in separated document. Access to the Setup can be protected by a password. TSensor program you can find on manufacture web http://www.cometsystem.cz or on the installation CD. This program is free for use and supports firmware update. The newest firmware is available at web pages too.

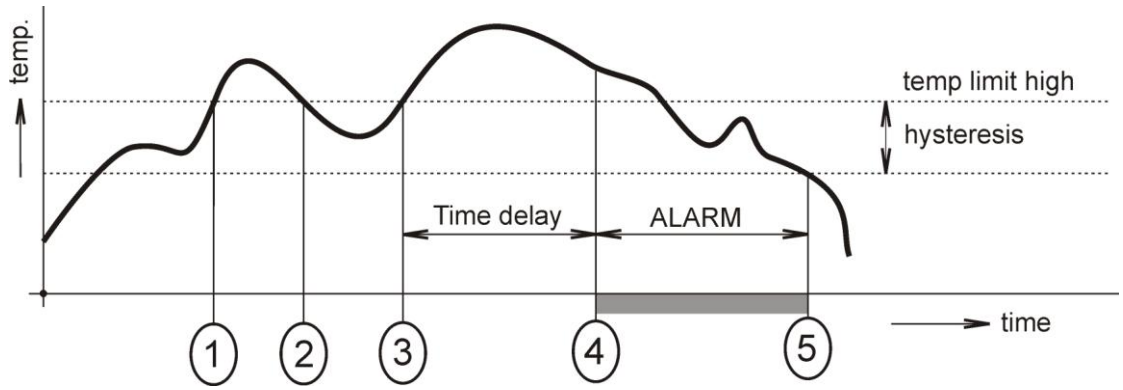
8.7. Alarms – Ethernet interface

8.7.1. Analogue values

It is possible to set an upper limit, lower limit, hysteresis and time delay to each measured value. Figure shows a temperature curve with some specified upper limit (temp_limit_high) and hysteresis. At point 1 temperature exceeds the limit. From that moment a time delay is counted (time_delay) after which an alarm is set. Because at point 2 the temperature dropped below the limit value (temp_limit_high) before the time delay expired, alarm was not set.

At point 3 the temperature again exceeded the limit, and because it did not drop below the limit value (temp_limit_high) before the time delay ended, the alarm was set at point 4. At this moment the alarm e-mails and traps are sent, if they are enabled, and the alarm flag is set (the flag is set when the alarm is active and reset when inactive). The state of the flag can be found on the WWW pages or via Modbus or the information console. The alarm lasted to point 5, where the temperature dropped below the limit value given by the adjusted hysteresis (hysteresis). For other measured values the principle of alarm activity is analogical.

[1] In telnet some settings are not allowed (display settings, computed value selection), see chapter ***8.4***

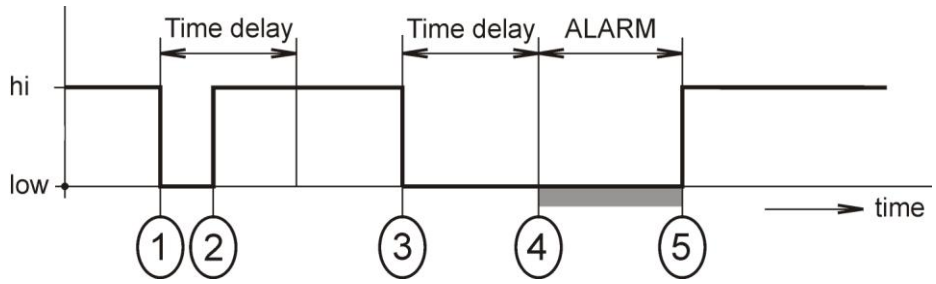


An alarm report is always sent right after an alarm appears. The device memorizes sent alarm reports of current alarms while the power is connected. In case of power disconnection or a reset of the device (e.g. by modification of configuration) a new alarm evaluation is performed and new alarm reports are sent again, if any.

It is possible to set the alarm parameters via telnet, Modbus protocol or a SNMPv1 protocol, TSensor program. Detailed description of setting via these protocols can be found in chapters informing about particular services.

8.7.2. Binary values

The binary values mean status of relay and binary inputs. Device can send warning message (e-mail, SNMP trap or Syslog message) in the course of relay or binary input change state. Every binary value has own "Time delay". Binary inputs can have a name (max. 14 characters).



A figure shows a simple example. Binary input 1 is configured to send an e-mail if input change state from high to low (lower edge). At point 1 a binary input was opened. Because at point 2 input was closed before the time delay expired, alarm was not set. At point 3 was input opened again. At point 4 the time delay expires and at this moment e-mail, SNMP traps are sent. The alarm lasted to point 5, where the input was closed.

8.8. Factory default – Ethernet interface

This procedure describe how set Ethernet interface of device to factory defaults (new IP address: `192.168.1.212`, mask: `255.255.255.0`).

1. power off device
2. remove device cover
3. close jumper near the Ethernet interface
4. power on the device
5. wait approximately 15s
6. open jumper (remove shorting link)
7. close device cover

9. Communication protocols

9.1. Modbus protocol

The device contains support for the Modbus TCP protocol to communicate with control systems. The port is set to 502. Port 502 enables full access, i.e. both read and write operations are supported. Access to port can be disabled in the Setup. Maximal number of client transaction is set to 1.

Supported Modbus commands:

Command	Code	Description
Read multiple register(s)	0x03	Reads 16 bit register(s)
Write multiple register(s)	0x10	Writes 16 bit register(s)

Modbus registers of regulator:

Variable	Unit	Format	Address [hex]	Address [dec]	Status
measured temperature	°C, °F	Int*10	0x0031	49	r
measured relative humidity (RH)	%	Int*10	0x0032	50	r
computed value (CV)	CV depend	Int*10	0x0033	51	r
measured barometric pressure	CV depend	Int*X ^{2}	0x0034	52	r
device serial number Hi	-	BCD	0x1035	4149	r
device serial number Lo	-	BCD	0x1036	5150	r
Relay1 status [0/1]	-	Int	0x003B	59	r
Relay2 status [0/1]	-	Int	0x003C	60	r
binary input 1 status [0/1]	-	Int	0x003D	61	r
binary input 2 status [0/1]	-	Int	0x003E	62	r
binary input 3 status [0/1]	-	Int	0x003F	63	r
far Relay1 control (see below) [0 – relay open, 1 – relay closed]	-	Int	0x0042	66	r/w
far Relay2 control (see below) [0 – relay open, 1 – relay closed]	-	Int	0x0043	67	r/w
status of all binary inputs (bit0, 1, 2)	-	Int	0x0008	8	r
status word (described below)	-	Int	0x0007	7	r
firmware version Hi	-	BCD	0x3001	12289	r
firmware version Lo	-	BCD	0x3002	12290	r
lower limit for temperature	°C, °F	Int*10	0x5001	20481	r/w
upper limit for temperature	°C, °F	Int*10	0x5002	20482	r/w

Variable	Unit	Format	Address [hex]	Address [dec]	Status
lower limit for humidity	%	Int*10	0x5003	20483	r/w
upper limit for humidity	%	Int*10	0x5004	20484	r/w
lower limit for computed value	CV depend	Int*10	0x5005	20485	r/w
upper limit for computed value	CV depend	Int*10	0x5006	20486	r/w
temperature hysteresis	°C, °F	Int*10	0x5007	20487	r/w
temperature time delay	s	uInt	0x5008	20488	r/w
RH hysteresis	%	Int*10	0x5009	20489	r/w
RH time delay	s	uInt	0x500A	20490	r/w
computed value hysteresis	CV depend	Int*10	0x500B	20491	r/w
computed value time delay	s	uInt	0x500C	20492	r/w
temperature alarm status	-	ASCII[a)]	0x500D	20493	r
RH alarm status	-	ASCII[a)]	0x500E	20494	r
computed value alarm status	-	ASCII[a)]	0x500F	20495	r
lower pressure limit	CV depend	Int*X	0x5010	20496	r/w
upper pressure limit	CV depend	Int*X	0x5011	20497	r/w
pressure hysteresis	CV depend	Int*X	0x5012	20498	r/w
pressure limit status	-	ASCII[a)]	0x5013	20499	r
pressure time delay	s	uInt	0x5014	20500	r/w
Relay1 alarm status	-	ASCII[b)]	0x5015	20501	r
Relay2 alarm status	-	ASCII[b)]	0x5016	20502	r
binary input 1 alarm status	-	ASCII[c)]	0x5017	20503	r
binary input 2 alarm status	-	ASCII[c)]	0x5018	20504	r
binary input 3 alarm status	-	ASCII[c)]	0x5019	20505	r
binary input 1 time delay	s	uInt	0x501A	20506	r/w
binary input 2 time delay	s	uInt	0x501B	20507	r/w
binary input 3 time delay	s	uInt	0x501C	20508	r/w

Legend:

- r — register is designed for read
- w — register is designed for write
- Int*10 — register is in format of integer*10
- Int*X — register is in format of integer*10, int*100, int*1000 depend on type[2]
- BCD — register is in format of BCD
- uInt — register is at range of 0-65535
- ASCII — character, where:

  a) Temperature, RH, computed value, pressure alarm status
  - no — no alarm
  - lo — value is bigger than specified upper limit
  - hi — value is lower than specified lower limit

  b) Relay alarm status:
  - op — no alarm
  - cl — relay is closed, alarm is signaled

  c) Binary inputs alarm status:
  - no — no alarm
  - lo — alarm on falling edge
  - hi — alarm on raising edge

[2] hPa, mBar, mmHg, inH_2O, oz/in^2 are Int*10, inHg, kPa are Int*100, PSI are Int*1000

- Status word: 16b value return, bite description:

Bit0	0/1	jumper open/closed
Bit3	0/1	Relay1 open/closed
Bit4	0/1	Relay2 open/closed
Bit5	0/1	internal acoustic alarm status
Bit6	0/1	binary input 1 status
Bit7	0/1	binary input 1 status
Bit8	0/1	binary input 1 status

- Far relay control: open/close relay through Modbus protocol. Before using remote relay control option is necessary setup FAR0 or FAR1 to the relay.

FAR0	remote relay control, after device reboot relay is open
FAR1	remote relay control, after device reboot

- Output relay alarm condition configuration: For more information please download appendix for user guide from www.cometsystem.cz.

9.2. SMTP

In case of exceeding adjusted limits of measured values the device can send e-mails to maximum of three addresses. It is necessary to set your SMTP server address (IP address, authentication, etc.) for correct function of e-mail sending.

If limits of several measured values are exceeded a special alarm e-mail is sent for each alarm state. Dummy address `sensor@[device IP address]` is displayed as a sender of the e-mail. It is not possible to reply to this address. In the Subject field of the message the sentence `Alarm [Description of the device]` is displayed or `Test message [Description of the device]` in the case of sending a test e-mail.

9.3. SNMPv1

By means of the SNMPv1 protocol it is possible to find currently measured values, read and set parameters concerning alarms. In case of alarm activation, warning message (a trap) can be sent to specified addresses. By means of the SNMPv1 protocol it is also possible to display history of last 100 measured values.

For read and write the device communicates via `UDP port 161`. Traps are sent via port `UDP port 162`. Sending of traps can be disabled in the Setup.

The following traps sent

`0/0`	device restart
`1/0`	testing trap
`1/1`	SNTP time synchronization error
`1/2`	Ethernet firmware was uploaded
`1/3 – 1/5`	SOAP communication error
`1/6 – 1/8`	e-mail sending error
`1/9`	Configuration changed via SNMP or Modbus
`6/3 – 6/55`	report on a measured value being outside of the limits or a return of the measured value to the limits

For the correct function of the SNMPv1 server it is necessary to store the MIB table `Hx5xx.mib` and `RFC-1213.mib` to the MIB client. The path to the device is then:

`iso.org.dod.internet.private.enterprises.comet.products.hx5xx`

MIB tables are available at WWW pages http://www.cometsystem.cz or on the installation CD in the MIB directory. Password for a read operation is set by the manufacturer to `public`, password for write is set to `private`. These passwords may be changed in the setup.

History

By means of the SNMPv1 protocol it is possible to display history of the last 100 measured values, stored in adjusted time interval. This interval is set by configuration program. If a value has not been measured yet or an error was detected the value is 9999, or -9999, if pressure is measured. The history is erased after each restart of the device. Restart occurred if device configuration is changed via keyboard or TSensor software.

9.4. WWW

The device supports display of measured values, adjusted limits and alarm states on its WWW pages. The address of the WWW pages is identical with its IP address. It is possible to upload self-made web pages to device. More info about user-defined web you can find on http://cometsystem.cz section programs.

Example: The device has an IP address `192.168.1.204`. Enter `http://192.168.1.204` to the browser address field and confirm it with the Enter key.

WWW pages have adjustable automatic refresh interval. The manufacturer sets it to 60 seconds. The value can be modified in the setup in a range of 10–65535s. If the device has WWW pages display disabled screen with message `Access denied`.

9.5. SNTP

The device allows time synchronization with SNTP server. The time synchronization is set to every 8 hours. If the time synchronization failed in next three hours, SNTP trap, e-mail and Syslog message will be sent.

9.6. Syslog protocol

Device allows send messages to selected Syslog server (`UDP` protocol, `port 514`). Events are described below.

Event	Text
device restart	`Device restart`
test message	`Testing message`
alarm occurred	`Alarm …`
SNTP connection error	`NTP connection error`
write to device via Modbus, SNMP	`Settings changed`
firmware was changed	`Firmware uploaded`
alarm is down	`Clearing …`
SOAP server communication error	`SOAP …`
e-mail sending error	`EMAIL …`

9.7. SOAP

Device allows sending SOAP messages with measured values to user defined remote web server in preset time intervals 10-65535 s. If the device cannot establish connection with the web server in the whole delay interval, device sends trap `1/3 - 1/5`. The file with XML schema is on www.cometsystem.cz/schemas/soapHx5xx.xsd.

How to configure sending SOAP messages example:

SOAP enable:	Yes
Target web page:	my.hosting.cz/soap/server.php
SOAP server IP address:	123.123.123.123
Source port:	0 (never set to 80, causes it web server collision)
Destination port:	80 (http servers usually listens at this port)
Sending interval:	10

10. What to do when…

10.1. I forgot the IP address of the device

Finding the device IP address

IP address is set to the value `192.168.1.213` by the manufacturer. If you changed it and forgot the new IP address, run the TSensor program and press the "`Find…`" button. In a new window all sensors will be show.

10.2. It is not possible to connect to the device from a LAN

In the "Find device" window is only IP and MAC address displayed

The next information is displayed as `N/A`. This problem will be occurred, when the device IP is set to another LAN.

In TSensor program choose `Find device/Change IP address`. Follow the program instruction.

The sensor IP address in Find device window is not displayed

In TSensor program select `Find device/Help my device Wasn't found!` Follow the program instruction.

Finding the MAC address

The MAC address is a unique address of a device which is necessary to be known e.g. in case when there are several devices connected to the network. MAC address is on device label.

It is not possible to find device after manual MAC enter

In TSensor program select `Find device/Help my device Wasn't found`. In this select `Set IP to ARP only`. Into `device MAC address` enter the meters MAC address (e.g. 00-20-4A-84-F0-80) and press the `Set IP` button.

Open telnet to the IP address you assigned to the device MAC address by running a telnet command `telnet [IP_address_assigned_to_MAC_address] 9999` and confirm with

the Enter key. Choose `0 - Global Settings`, set the meters IP address, clear the gate IP, no. of net mask set to 0. Pres the Enter key, until you are not back into a menu. `Press - 9 Save and Exit`. The connection will be closed. Now you can connect to meter by the `TSensor` program.

10.3. LCD display is Off

- check if power supply is connected properly
- disconnect and connect the power supply - watch the display at the moment of connecting the power. If all LCD segments light for 1 second and go out again, the display is turned off by the software

10.4. Error States of the device

Device continuously checks its state during operation. In case error is found LCD displays corresponding error code:

Error 0 - first line of LCD displays „Err0“. Check sum error of stored setting inside device’s memory. This error appears if incorrect writing procedure to device’s memory occurred or if damage of calibration data appeared. At this state device does not measure and calculate values. It is a serious error, contact distributor of the device to fix.

Error 1 - measured or calculated value except in pressure is over upper limit of allowed full scale range. There is a reading „Err1“ on LCD display. Value read from the device is +999.9. This state appears in case of:

- Measured temperature is higher than approximately 600°C (i.e. high non-measurable resistance of temperature sensor, probably opened circuit).
- Relative humidity is higher than 100%, i.e. damaged humidity sensor, or humidity calculation of humidity is not possible (due to error during temperature measurement).
- Computed value – calculation of the value is not possible (error during measurement of temperature or relative humidity or value is over range).

The value of pressure +999.9 hPa is correct value!

Error 2 - first line of LCD displays „Err2“. Measured or calculated value is below lower limit of allowed full scale range. Value read from the device is -999.9. This state appears in case of:

- Measured temperature is lower than approximately -210°C (i.e. low resistance of temperature sensor, probably short circuit).
- Relative humidity is lower than 0%, i.e. damaged sensor for measurement of relative humidity, or calculation of humidity is not possible (due to error during temperature measurement).
- Measured pressure value **with added correction for altitude** is outside of range from 300 hPa to 1350 hPa (from 4.351 PSI to 19.580 PSI) or the pressure sensor is damaged. Please check setting of pressure correction for altitude with User’s software.
- Computed value – calculation of computed value is not possible (error during measurement of temperature or relative humidity).

Error 3 - there is a reading „Err3“ on LCD display upper line. Error of internal A/D converter appeared (converter does not respond, probably damage of A/D converter). This error does NOT affect pressure measurement. Rest values are not measured. It is a serious error, contact distributor of the device.

Error 4 - there is a reading „Err4“ on LCD display. It is internal device error during pressure sensor initialization. Under this condition device does NOT measure atmospheric pressure. Value read from device is -999.9. Pressure sensor is probably damaged. It is a serious error, contact distributor of the device.

Error 5,6 - there is problem with assigned value to output relay, there is some wrong setting (mismatch). This error appears if incorrect writing procedure to device's memory occurred.

Error 9 - inserted password is not valid, there is shown for short time message "Err9" on LCD display.

11. Readings on LCD display

°C, °F reading next to this symbol is measured temperature or error state of value

%RH reading next to this symbol is measured relative humidity or error state of value

hPa, PSI, inHg reading next to this symbol is measured pressure or error state of value. If selected pressure unit is **mBar** or **oz/in^2** or **mmHg** or **inH$_2$O** or **kPa**, there is shown only value (number) without corresponding pressure unit!

°C / °F DP reading next to this symbol is calculated dew point temperature or error state of value

g/m^3 reading next to this symbol is calculated absolute humidity or error state of value

g/kg reading next to this symbol is calculated specific humidity or mixing ratio (depends on device setting) or error state of value

3 this symbol is on if jumper is closed

If specific enthalpy is selected, there is shown only value (number) without corresponding unit.

12. Preventive maintenance and calibration

Pay heed to recommended calibration interval. Do not subject the device to mechanical stress.

Recommended calibration intervals:

- H0530 2 years
- H3530 1 year
- H3531 1 year
- H3531P 1 year
- H4531 2 years
- H7530 1 year
- H7531 1 year

13. Technical specification

13.1. Technical parameters

13.1.1. Common parameters

Power voltage: 9 to 30 V DC
Power consumption: approx. 1W + consumption of sensors and detectors connected to +U terminals
Power connector: coaxial connector, diameter 5,5 x 2,1 mm, (+) internal contact
Measuring interval: 2s
Display switching interval: 4 s (when more than two values are displayed)
Communication with computer: Ethernet connection (RJ-45 connector)
Protection: IP40
Relay outputs:
- Amount: 2
- Maximal voltage: 50 V
- Maximal current: 2A
- Maximal power: 60 VA
- Relays contact is not designed for direct control of line voltage!
- (output relay contact parameters: max 220Vdc, 125Vac, 2A, 60 W, 62.5 VA)

Binary inputs:
- Amount: 3
- Signal for binary input: from floating contact or binary voltage
- Caution! Binary inputs are not galvanic isolated!
- Min. input pulse duration: 500 ms (detection of shorter pulses is not guaranteed)
- Current through closed contact: 25 μA
- Open contact voltage: < 3,3 V
- Maximal input voltage: +30 V
- Low level input voltage: 0 to +0,5 V
- Hi level input voltage: +3,0 to +30 V
- Auxiliary power supply +U: 9 to 30 V DC, overall current max. 500 m A
- Cable for input signal wiring: shielded, max. 10 m long, cable should not be led in parallel along power cabling.

EMC: EN 61326-1, EN 55011, EN55022

13.1.2. H0530 - temperature regulator

Temperature:
- Accuracy: ± 0,4 °C (±0,7 °F)
- Range: -30 to +80 °C (-22 to 176 °F)
- Resolution: 0,1 °C (0,2 °F)

13.1.3. H3530 - relative humidity and temperature regulator

Temperature:
- Accuracy: ± 0,4 °C (±0,7 °F)
- Range: -30 to +80 °C (-22 to 176 °F)
- Resolution: 0,1 °C (0,2 °F)

Relative humidity:

Accuracy: ± 2,5 %RH from 5 to 95 %RH at 23 °C (73,4 °F)
Range: 0 to 100 %RH, temperature compensated
Resolution: 0,1 %RH

Measuring temperature and humidity range is limited in accordance with the graph below

13.1.4. H3531(P) - temperature and humidity regulator

Temperature:

Accuracy: ± 0,4 °C (±0,7 °F)
Range: -30 to +105 °C (-22 to 221 °F), includes probe cable
Resolution: 0,1 °C (0,2 °F)

Relative humidity:

Accuracy: ± 2,5 %RH from 5 to 95 %RH at 23 °C (73,4 °F)
Range: 0 to 100 %RH, temperature compensated
Resolution: 0,1 %RH

Measuring temperature and humidity range is limited in accordance with the graph below

Response time with stainless steel mesh sensor cover (F5200B) and bronze sensor cover (F0000 - selectable option), air flow approximately 1 m/s:

temperature: H3531 t90 < 6 min (temperature step 20 °C (36 °F))
H3531P t90 < 16 min (temperature step 20 °C (36 °F))
relative humidity: t90 < 30 s (humidity step 65 %RH, constant temperature)

13.1.5. H4531 - temperature regulator, external probe

Probe: Pt1000/3850 connected by shielded cable of maximum length 10m
Range: -200 to +600 °C (-328 °F to 998.6 °F) (by applied temperature probe)
Resolution: 0,1 °C (0,2 °F)
Accuracy: ±0,2 °C (±0,4 °F) without probe

13.1.6. H7530 - Barometric pressure, RH and temperature regulator

Temperature and relative humidity parameters correspond to H3530 type, barometric pressure parameters corresponds to H7531 type (see below).

13.1.7. H7531 - Barometric pressure, RH and temperature regulator

Technical parameters are the same as regulator H3531, plus barometric pressure:

Unit	**hPa, mBar**	**PSI**	**mmHg**	**inHg**	**inH_2O**	**oz/in^2**	**kPa**
Range	600	8.70	450.0	17.72	240.9	139.2	60.00
	1100	15.95	825.1	32.48	441.6	255.3	110.0
accuracy							
T=23 °C (T=73,4°F)	±1.3	±0.02	±1.0	±0.04	±0.5	±0.3	±0.13
0≤T≤40°C(32≤T≤104°F)	±1.5	±0.02	±1.1	±0.04	±0.6	±0.3	±0.15
Else	±2.0	±0.03	±1.5	±0.06	±0.8	±0.5	±0.20

Response time[3]: pressure: t90 <44s

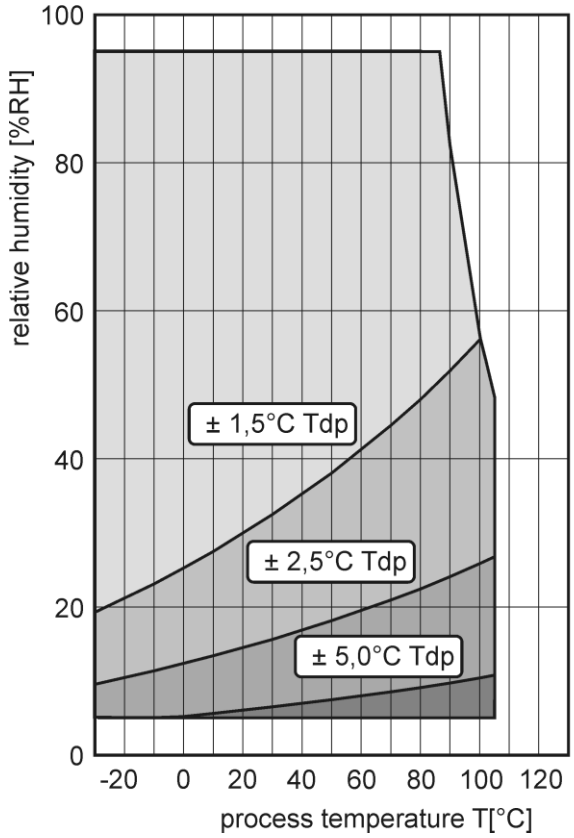
[3] There is possible to change response time. For more details see file "Description of calibration and adjustment procedure.pdf", which is installed together with Users software.

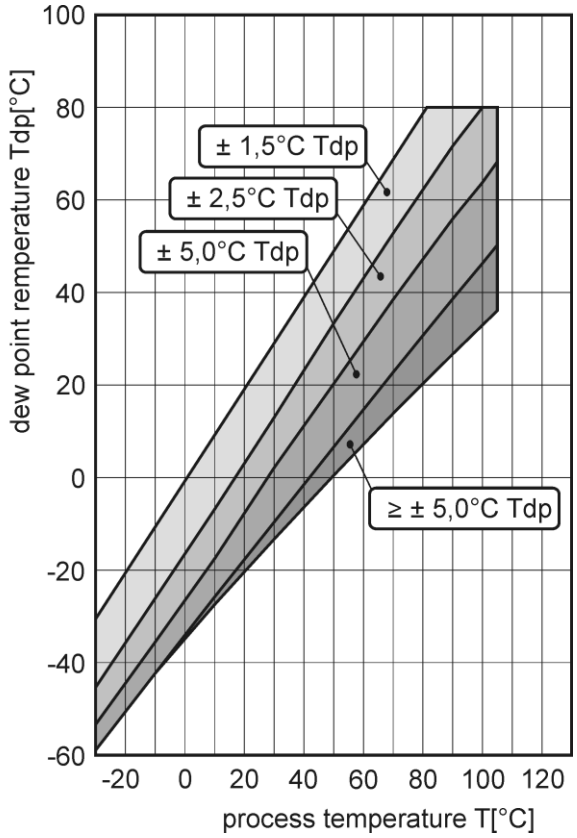
13.1.8. Value computed from measured relative humidity and temperatur

Dew point temperature

Range: -60 to +80 °C (-76 to 176 °F)

Accuracy: ±1,5°C (±2,7°F) at ambient temperature T<25°C (77°F) and relative humidity RH >30%, for more details see graphs below

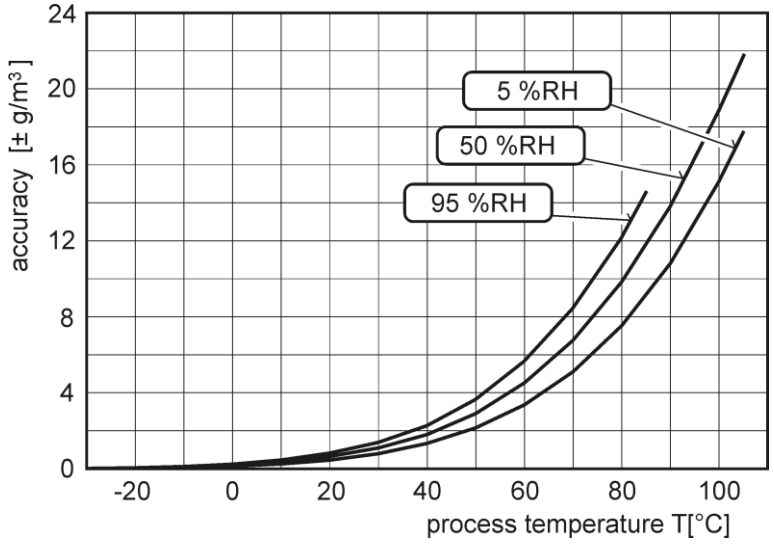




Absolute humidity

Range: 0 to 400 g/m^3

Accuracy: ±1,5 g/m^3 at ambient temperature T < 25°C (104 °F), for more details see graph below



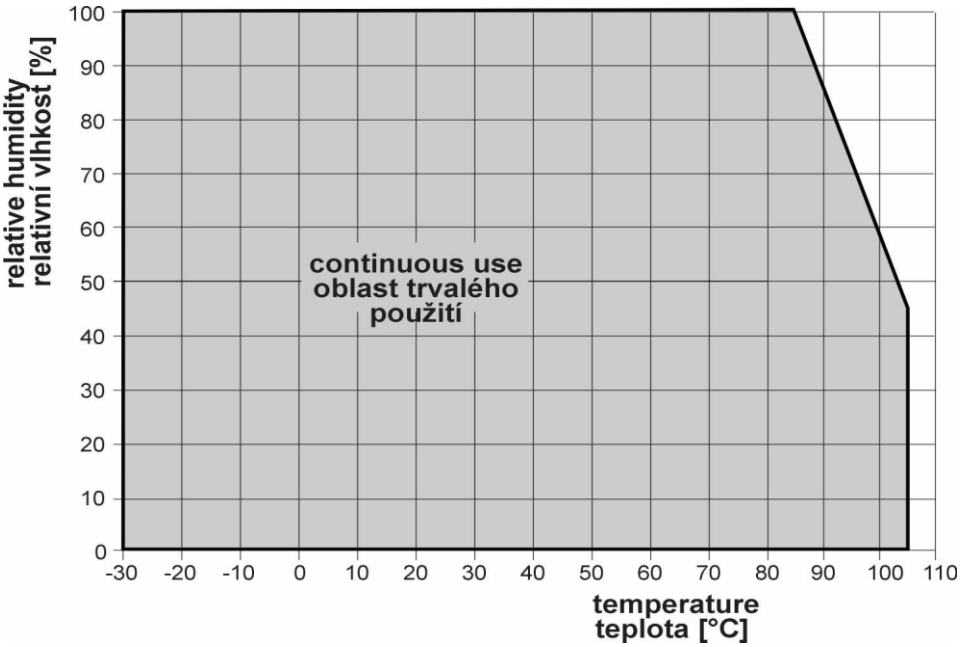
Specific humidity[4]
Accuracy: ±2g/kg at ambient temperature T < 35°C (95 °F)
Range: 0 to 550 g/kg

Mixing ratio[4]
Accuracy: ±2g/kg at ambient temperature T < 35°C (95 °F)
Range: 0 to 995 g/kg

Specific enthalpy[4]
Accuracy: ± 3kJ/kg at ambient temperature T < 25°C (77 °F)
Range: 0 to 995 kJ/kg[5]

The values computed from ambient temperature and relative humidity including their accuracy you can exactly determine by the program **Conversions**. It is free to download at http://www.cometsystem.cz .

13.1.9. Relative humidity and temperature restriction



13.2. Operating conditions

Operating temperature and relative humidity:

electronics : -30 to +80 °C (-22 to 176 °F), 0 to 100 % RH (without condensation)
probe H3531(P), H7531: -30 to +105 °C (-22 to 221 °F) cable included, 0 to 100 %RH
external probe for H4531: by probe type (not included)
It is recommended to switch off the LCD display at ambient temperatures above 70°C (158 °F) around electronics.

[4] This value depends on the atmospheric pressure. For computing is used constant value stored in device memory. Default value preset by manufacturer is 1013hPa and can be changed by user's software.
[5] This maximum is reached under conditions about 70°C/100%RH or 80°C/70%RH

Operating pressure range of probe H3531P: up to 25 bar

Air flow velocity (H3531P probe): up to 25 m/s at a pressure of 1bar (1m/s at a pressure of 25 bar)

Working position:

H3531(P), H4531, H7531: negligible
H0530, H3530, H7530: with sensor cover downwards

Not allowed manipulations: It is not allowed to operate the device under conditions other than specified in technical parameters. Devices are not designed for locations with chemically aggressive environment. Temperature and humidity sensors must not be exposed to direct contact with water or other liquids. It is not allowed to remove the sensor cover to avoid any mechanical damage of the sensors.

Storage conditions: -30 to +80 °C (-22 to 176 °F), 0 to 100 % RH (without condensation)

Mechanical connection of probe H3531P: G1/2 with O-ring

Dimensions: see dimensional drawings

Weight: approximately

H0530, H4531	340g
H3530, H7530	360g
H3531/1m probe, H7531/1m probe	410g
H3531/2m probe, H7531/2m probe	450g
H3531/4m probe, H7531/4m probe	530g
H3531P/1m	460g
H3531P/2m	500g
H3531P/4m	580g

Material of the case: ABS

Material of the probe H3531P: duralumin with the black eloxal surface finish

13.3. End of operation

Device itself (after its life) is necessary to liquidate ecologically!

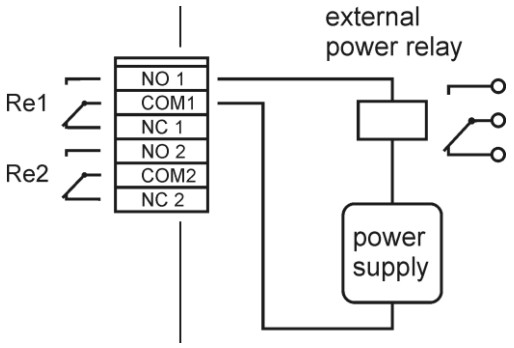
13.4. Technical support and service

The adjustment procedure is described at file „*Calibration manual.pdf*“ which is installed commonly with the TSensor software.

Technical support and service is provided by distributor. For contact see warranty certificate. You can use discussion forum at web address: http://www.forum.cometsystem.cz/.

14. Appendix A

Connection of external power relay

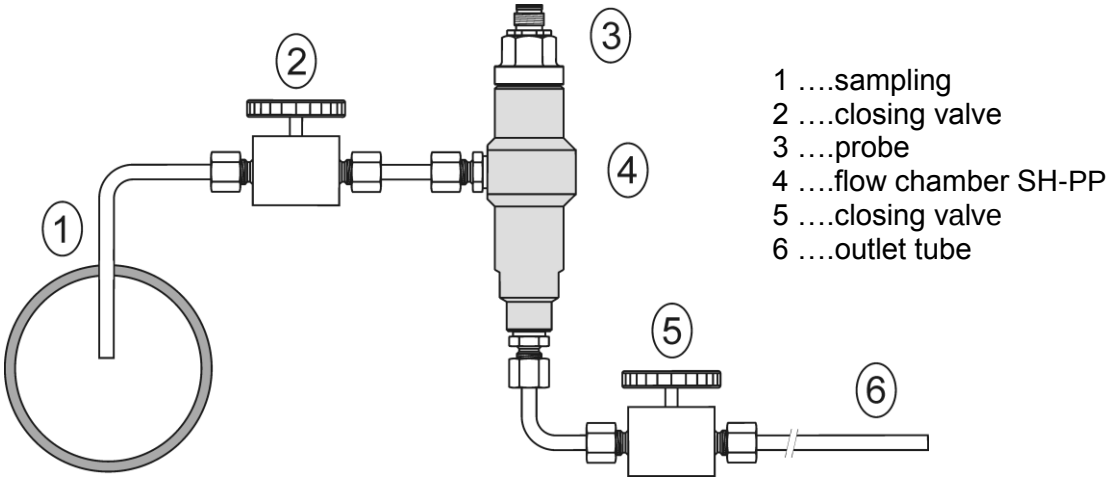


Coil data chart of external power relay:

nominal voltage : max 50V
nominal power: max 60VA
current: max 2A

15. Appendix B

The probe for measuring the moisture of compressed air should be placed directly on the pressure pipelines to achieve higher measurement accuracy and fast response times. But they are cases where such placement is not possible. The reason is the high air speed, high temperature, high pollution, small diameter pipes, etc. Such situation can be solved by placing the probe into the flow measuring chamber. The picture shows the basic layout of the sampling system with chamber SH- PP.



sampling (1) - end of the tube placed in the centre of pressure pipelines (distribution of moisture in the pipe cross-section is not homogeneous). To achieve fast response times to shorten the length of the sample tubes to a minimum (few meters).

closing valve (2) - allows access to the sample system without interrupting the main line

closing valve (5) - the sample flow is regulated by this valve. Measurement accuracy is typically not affected by the sample flow rate, but at low speeds, increasing response time.

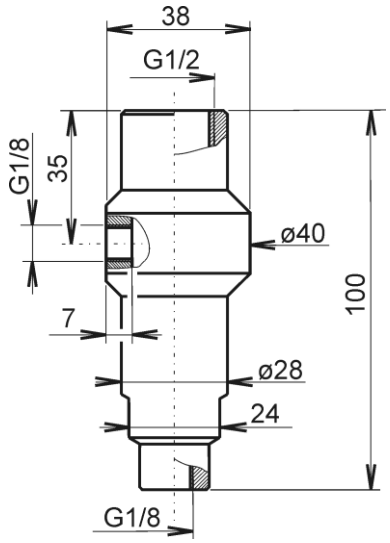
outlet tube (6) - if the measured sample of air is released into the atmosphere, select the length of the outlet tube of 1.5 m (recommended for tube diameter 6mm). The reason is to ensure the accuracy of the sample in the flow chamber and avoid back diffusion of moisture from the ambient air..

That basic structure of sampling system can be supplemented with filters, coolers, flow measurement, pressure measurement, etc. For the accurate operation of sampling system is important to ensure perfect tightness of all connections and to use corrosion-resistant materials. Tube inclination is chosen so as to avoid the accumulation of fluid in the system.

Technical specification – flow chamber SH-PP

Material of flow chamber:	stainless steel (DIN 1.4301)
Inlet and outlet connection:	G1/8
Probe connection:	G1/2
Sample flow rate:	0.1 to 3 l/min
Operating pressure:	up to 25 bar
Weight:	580 g

Note: Screw-coupling not included



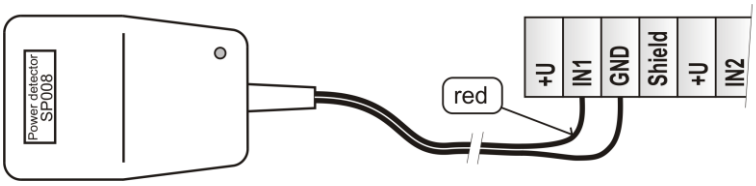
16. Appendix C

This chapter contains basic information about connection of the detectors (optional accessories) to binary inputs of regulator. The detectors install in accordance with the attached instructions for use.

SP008 power detector

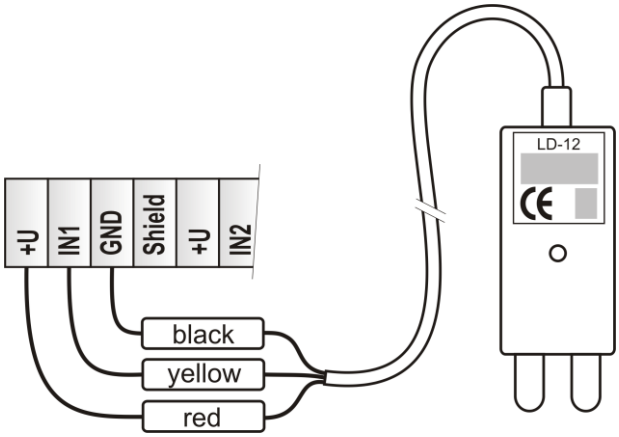
AC voltage presence sensor with optical indicator (green LED).

input voltage : 230Vac/50Hz
power plug : type C
response time : approx. 1 sec



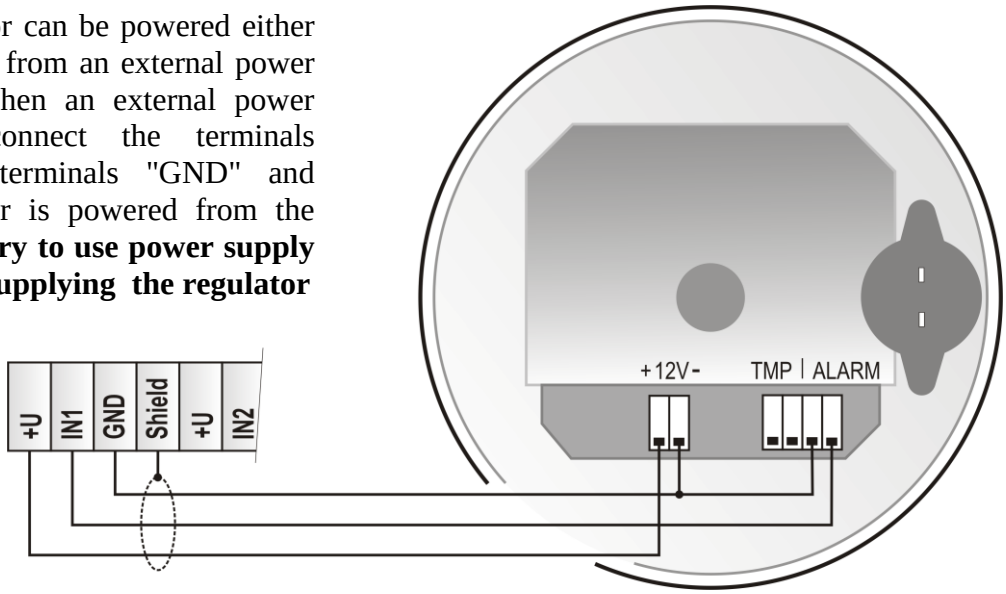
LD-12 flood detector

This detector is a water flood indicator for cellars, bathrooms, … The detector can be powered either from the regulator, or from an external power supply of 12Vdc. When an external power supply is used, connect the black wire to the terminal "GND", yellow wire to the terminal "IN1", (-) terminal of the power source to the terminal "GND" and the (+) terminal of the source to the red wire. If the detector is powered from the regulator **it is necessary to use power supply of 12Vdc for power supplying the regulator.**



SD-280 optical smoke detector

This device is designed to detect the presence of fire inside residential or commercial buildings. The detector can be powered either from the regulator, or from an external power supply of 12Vdc. When an external power supply is used, connect the terminals “ALARM” to the terminals "GND" and "IN1". If the detector is powered from the regulator **it is necessary to use power supply of 12Vdc for power supplying the regulator**



Notice: The connecting cables should be located as far as possible from the potential interference sources. The cable shield connect to “Shield” terminal of regulator only.